NASAfacts

Cubesat Proximity Operations Demonstration

In-Orbit Demonstration of Rendezvous, Proximity Operations and Docking of Two 3U Cubesats

The CubeSat Proximity Operations Demonstration (CPOD) project will demonstrate rendezvous, proximity operations and docking (RPOD) using two 3-unit (3U) CubeSats. Each CubeSat is a satellite with the dimensions 4 inches x 4 inches x 13 inches (10 centimeters x 10 centimeters x 33 centimeters) and weighing approximately 11 pounds (5 kilograms). This flight demonstration will validate and characterize many new miniature low-power proximity operations technologies applicable to future missions. This mission will advance the state of the art in nanosatellite attitude determination, navigation and control systems, in addition to demonstrating relative navigation capabilities. The two CPOD satellites are scheduled to be launched together to low-Earth orbit no earlier than Feb. 1, 2016.

The Tyvak Nano-Satellite Systems, Inc. designed CPOD 3U CubeSat incorporates a suite of RPOD sensors, high performance low power processors, modular flight software, and an advanced control system that includes a multi-thruster propulsion system.

CPOD will demonstrate the ability of the two spacecraft to remain at determined points relative to each other, which is known as relative station keeping. CPOD will also demonstrate precision circumnavigation and docking. Docking will employ the use of a novel universal docking device, imaging sensors, and a multi-thruster cold gas propulsion system.

Many of the proximity operations test scenarios will be performed autonomously using high-performance, on-board processors and flight software. The satellite design leverages existing and next-generation, high-performance systems, including sensors and flight software for guidance, navigation and control. The CPOD satellites have 3-axis attitude determination and control and large power charging capacity and storage. The system also contains a half-duplex (one-way communication) ultra high frequency (UHF) communications system with a high-speed, S-band downlink for payload data transfer.

The two satellites will be deployed into orbit simultaneously while attached side-by-side and will initially undergo a series of checkout steps to ensure proper operation and maneuvering capability. Once the initial checkout is complete, the two spacecraft will then release from each other and will begin the proximity operations maneuvers. The space-to-ground data link from each satellite will enable transmission of images of the other satellite. The two spacecraft will use an inter-satellite link to share GPS and other data.

Using on-board navigation systems, one satellite will perform a series of circumnavigation maneuvers relative to the second satellite in order to validate and characterize performance of the new miniature sensors. After the sensors have been characterized, the chaser satellite will begin closing the distance to the first satellite during a series of planned maneuvers. Finally, when they have reached a close relative range, they will conduct the last portion of the mission by engaging the docking mechanism and performing a full docking of the two spacecraft.

This mission opens a new frontier for exploration and operations with small spacecraft. The maturation of these capabilities will enable new applications for small spacecraft to

explore asteroids, planets, moons, and to inspect other spacecraft. In addition, the CPOD mission enhances the capability of small spacecraft to work in coordination with one another for observations or to become in-space building blocks for more sophisticated systems.

The CPOD project is led by Tyvak Nano-Satellite Systems Inc. of Irvine, California. The company has partnered with Applied Defense Solutions Inc. of Columbia, Maryland, and the California Polytechnic State University of San Luis Obispo, California.

The CPOD mission is funded through NASA's Small Spacecraft Technology Program (SSTP), which is chartered to develop and mature technologies to enhance and expand the capabilities of small spacecraft with a particular focus on communications, propulsion, pointing, power and autonomous operations. SSTP is one of nine programs within NASA's Space Technology Mission Directorate.

For more information about the SSTP, visit:
http://www.nasa.gov/smallsats

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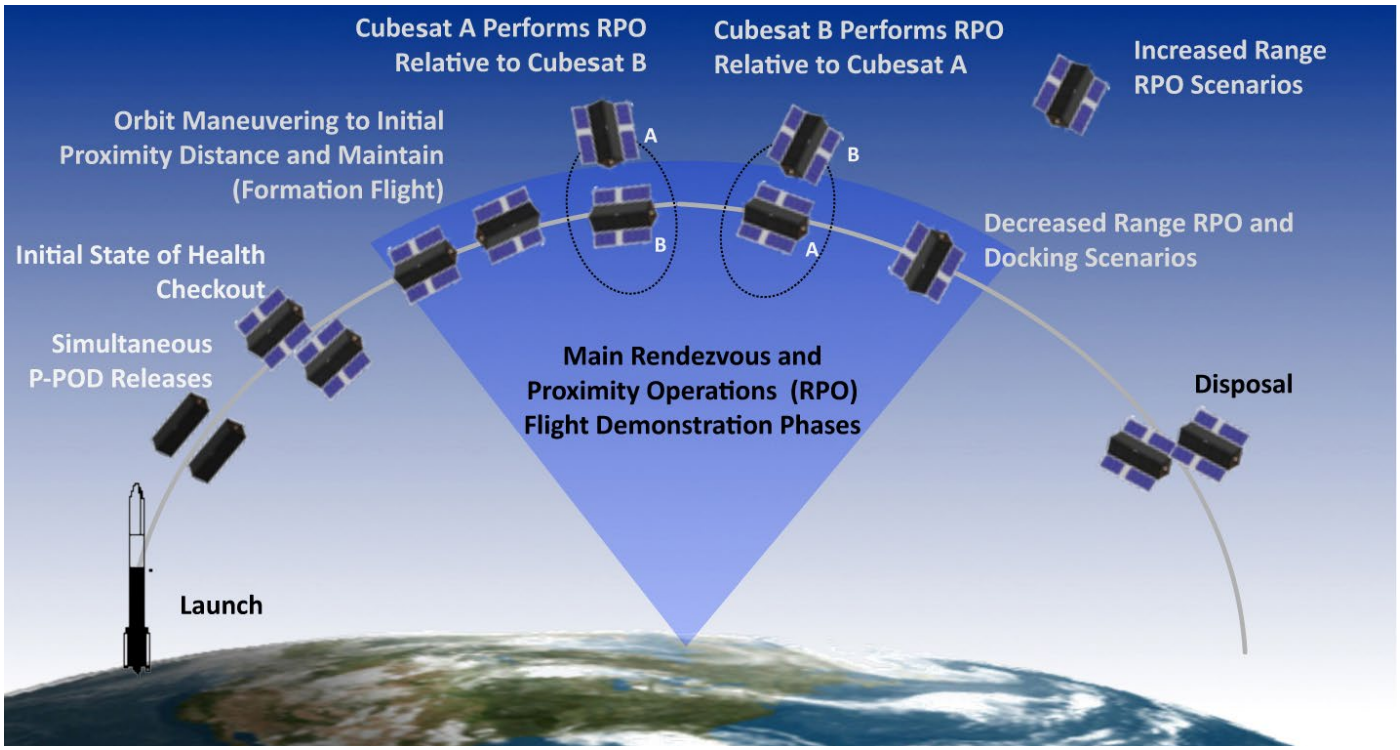

The CPOD mission utilizes several mission phases to demonstrate a range of RPOD scenarios in order to validate and characterize the low power miniature systems for application to future NASA missions.

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